1 PRODUCT OVERVIEW

OVERVIEW

The S3C72H8 single-chip CMOS microcontroller has been designed for very high performance using Samsung's state-of-the-art 4-bit product development approach, SAM47 (Samsung Arrangeable Microcontrollers). Its main features are an up-to-13-digit LCD direct drive capability, 2-channel comparator inputs and outputs, and versatile 8-counter/ timers and 16-bit frequency counter. The S3C72H8 gives you an excellent design solution for a variety of LCD-related applications, specially thermostat control application.

Up to 21 pins of the available 64-pin QFP packages can be dedicated to I/O. And six vectored interrupts provide fast response to internal and external events.

In addition, the S3C72H8's advanced CMOS technology provides for low power consumption and a wide operating voltage range.

FEATURES

Architecture

– SAM47 4-bit CPU core

Memory

– Data Memory: 512 × 4 bits

– Program Memory: 8196 × 8 bits (Including LCD display RAM)

Memory-Mapped I/O Structure

– Data memory bank 15

Interrupts

– Three internal vectored interrupts

– Three external vectored interrupts

– Two quasi-interrupts

8-Bit Timer/Counter (T0)

– Programmable 8-bit timer

– External event counter

– Arbitrary clock frequency output

– External clock signal divider

16-Bit Frequency Counter (FC)

– a 16-bit binary up-counter

– External event counter

– Gate function control

Watch-Dog TIMER and Basic Timer

– 8-bit counter + 3-bit counter

– Overflow signal of 8-bit counter makes a basic timer interrupt. And control the oscillation warm-up time

– Overflow signal of 3-bit counter makes a system reset

Watch Timer

– Real-time and interval time measurement

– Four frequency outputs to buzzer sound

– Clock source generation for LCD

LCD Controller/Driver

– 26 segment and 4 common terminals

– Maximum 13-digit LCD direct drive capability

– Display modes: Static, 1/2, 1/3, 1/4 duty

– Voltage regulator and booster (1/3 bias: 1, 2, or 3V, 1/2 bias: 1.5, 3V)

Analog Comparator

– 2 Ch Comparator (Each CnP, CnN, CnOUT pins)

Bit Sequential Carrier

– Support 16-bit serial data transfer in arbitrary format

I/O Ports

– 21 pins for standard I/O

– 26 pins for LCD segment output

– 4 pins for LCD common output

– Two input pins for external interrupts

Oscillation Sources

– Crystal, ceramic, or RC for main system clock

– Crystal or external oscillator for subsystem clock

– Main system clock frequency: 4.19 MHz (typical)

– Subsystem clock frequency: 32.768 kHz

– CPU clock divider circuit (by 4, 8, or 64 main, and by 4 for sub clock)

Power Down Mode

– Idle mode (only CPU clock stops)

– Stop mode (main or sub-system oscillation stops)

Voltage Level Detector

– V_{DD} level detection circuit (2.2, 2.4, 3, or 4.0V)

– External pin level detect mode

Operating Voltage Range

– 1.8V to 5.5V at 3 MHz

– 2.0V to 5.5V at 4.19 MHz

Package Type

– 64-pin QFP

BLOCK DIAGRAM

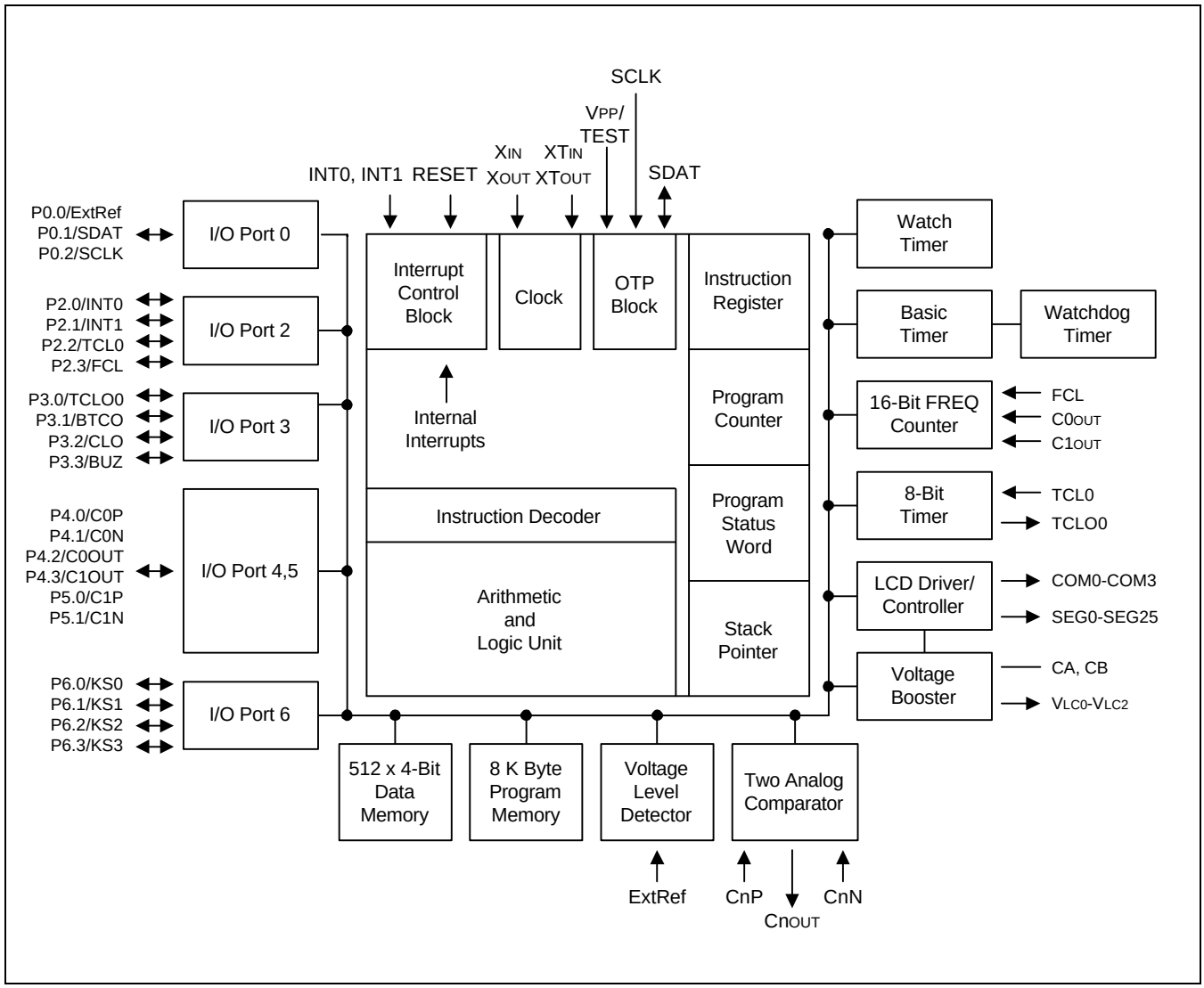


Figure 1-1. S3C72H8 Simplified Block Diagram

PIN ASSIGNMENTS

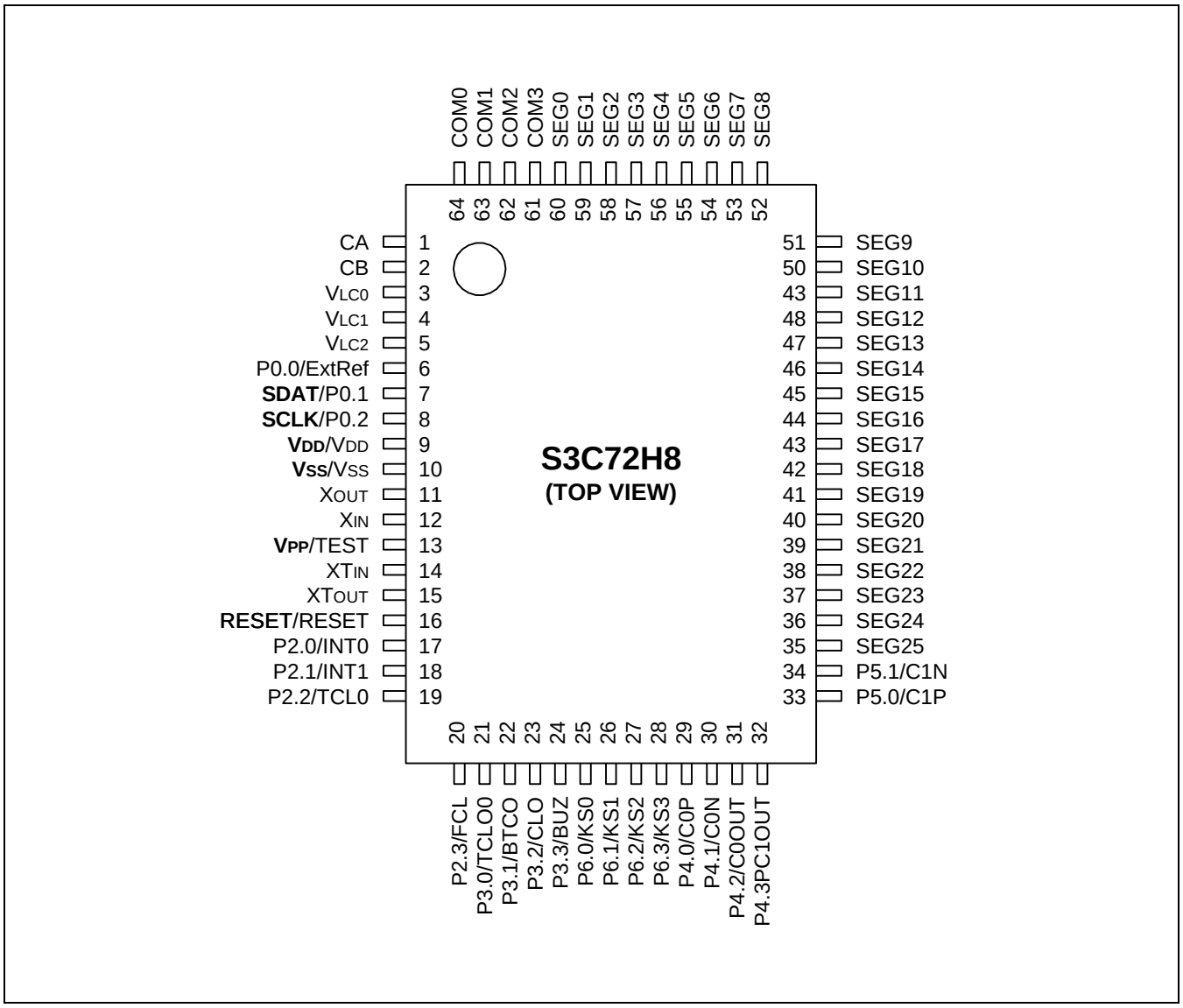


Figure 1-2. S3C72H8 Pin Assignment Diagram

PIN DESCRIPTIONS

Table 1-1. S3C72H8 Pin Descriptions

Pin Name	Pin Type	Description	Number (64-QFP)	Share Pin	Circuit Type
P0.0 P0.1 P0.2	I/O	3-bit I/O port. 1-bit and 4-bit read/write and test is possible. Port 0 is software configurable as input or output. 3-bit pull-up resistors are software assignable.	6 7 8	ExtRef – –	D-1
P2.0 P2.1 P2.2 P2.3	I/O	4-bit I/O port. 1-bit and 4-bit read/write and test is possible. Individual pins are software configurable as input or output. 4-bit pull-up resistors are software assignable.	17 18 19 20	INT0 INT1 TCL0 FCL	D-1
P3.0 P3.1 P3.2 P3.3	I/O	Same as port 2. Ports 2 and 3 can be addressed by 1, 4, and 8-bit read/write and test instruction.	21 22 23 24	TCLO0 BTCO CLO BUZ	D-1
P4.0-P4.3 P5.0-P5.1	I/O	4/2-bit I/O ports. N-channel open-drain or push-pull output. 1, 4, and 8-bit read/write and test is possible. Ports 4 and 5 can be paired to support 8-bit data transfer. Pull-up resistors are assignable to port unit by software control.	29-32 33-34	C0P/ C0N/ C0OUT/ C1OUT C1P/ C1N	E-1
P6.0-P6.3	I/O	4-bit I/O ports. Port 6 pins are individually software configurable as input or output. 1-bit and 4-bit read/write and test is possible. 4-bit pull-up resistors are software assignable.	25-28	KS0-KS3	D-1
BTCO	I/O	Basic timer clock output	22	P3.1	D-1
CLO	I/O	CPU clock output	23	P3.2	D-1
BUZ	I/O	2, 4, 8 or 16 kHz frequency output for buzzer sound with 4.19MHz main-system clock or 32.768 kHz sub-system clock.	24	P3.3	D-1
X_{OUT}, X_{IN}	–	Crystal, ceramic, or RC oscillator signal for main-system clock. (For external clock input, use X_{IN} and input X_{IN}'s reverse phase to X_{OUT})	11, 12	–	–
XT_{OUT}, XT_{IN}	–	Crystal oscillator signal for sub-system clock. (For external clock input, use XT_{IN} and input XT_{IN}'s reverse phase to XT_{OUT})	14, 15	–	–
INT0, INT1	I/O	External interrupts. The triggering edge for INT0 and Int1 is selectable. Only INT0 is synchronized with the system clock.	17, 18	P2.0, P2.1	D-1

Table 1-1. S3C72H8 Pin Descriptions (Continued)

Pin Name	Pin Type	Description	Number (64-QFP)	Share Pin	Circuit Type
KS0-KS3	I/O	Quasi-interrupt input with falling edge detection	25-28	P6.0-P6.3	D-1
ExtRef	I/O	External Reference input	6	P0.0	D-1
TCL0	I/O	External clock input for timer/counter 0	19	P2.2	D-1
FCL	I/O	External clock input for frequency counter	20	P2.3	D-1
TCLO0	I/O	Timer/counter 0 clock output	21	P3.0	D-1
COM0-COM3	O	LCD common signal output	61-64	–	H-16
SEG0-SEG25	O	LCD segment output	35-60	–	H-16
CA, CB	–	Voltage booster capacitor pins	1, 2	–	–
V_{LC0}-V_{LC2}	–	Voltage booster output pins (V_{LC0} is the regulated output, V_{LC1} is the 2* V_{LC0} output, V_{LC2} is the 3* V_{LC0} output)	3-5	–	–
C0P, C0N, C0OUT	I/O	Comparator 0 non-inverting input, inverting input and output. C0Out can be configured as C-MOS push-pull or N-Ch open drain output	29-31	P4.0-P4.2	–
C1P, C1N, C1OUT	I/O I	Comparator 1 non-inverting input, inverting input and output. C1Out can be configured as C-MOS push-pull or N-Ch open drain output	32-34	P4.3-P5.1	–
RESET	–	Reset signal for chip initialization	16	–	B
V_{DD}	–	Main power supply	9	–	–
V_{SS}	–	Ground	10	–	–
TEST	–	Test signal input (must be connected to V_{SS})	13	V_{PP}	–
SDAT	I/O	Serial data for OTP programming	7	P0.1	
SCLK	I/O	Serial clock for OTP programming	8	P0.2	
V_{PP}	–	Power supply pin for EPROM cell writing	13	TEST	

NOTE: Pull-up resistors for ports 0, 2, 3, and 6 are automatically disabled if they are configured to output mode. But pull-up resistors for ports 4 and 5 are retained its state even though they are configured to output mode.

PIN CIRCUIT DIAGRAMS

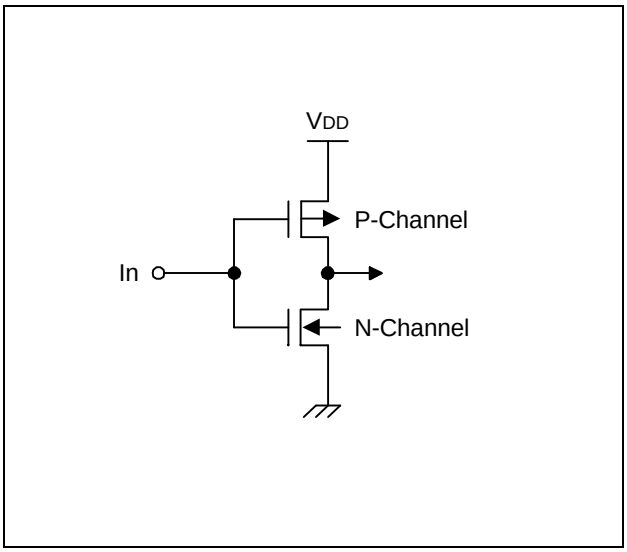


Figure 1-3. Pin Circuit Type A

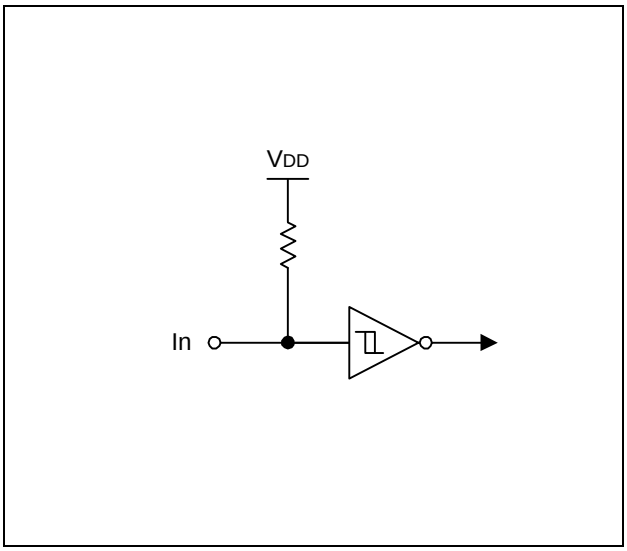


Figure 1-4. Pin Circuit Type B (Reset)

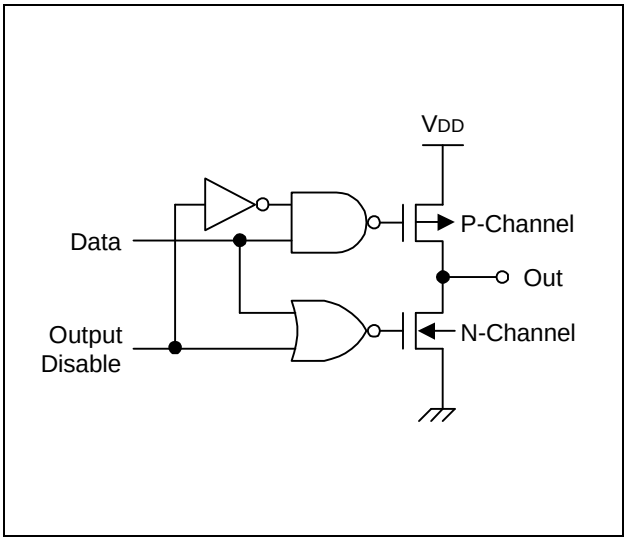


Figure 1-5. Pin Circuit Type C

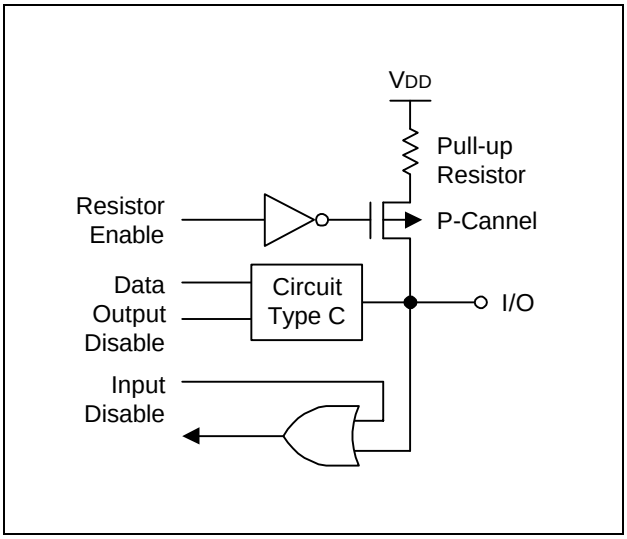


Figure 1-6. Pin Circuit Type D-1 (P0, P2, P3, P6)

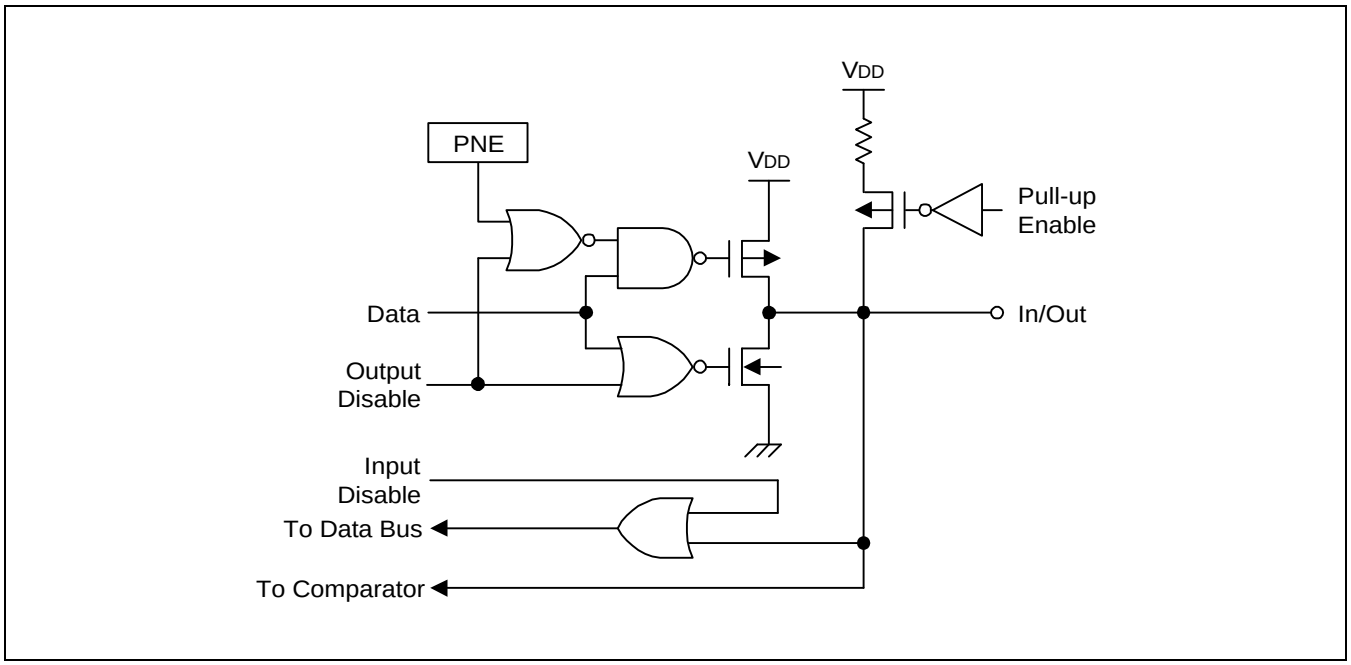


Figure 1-7. Pin Circuit Type E-1 (P4, P5)

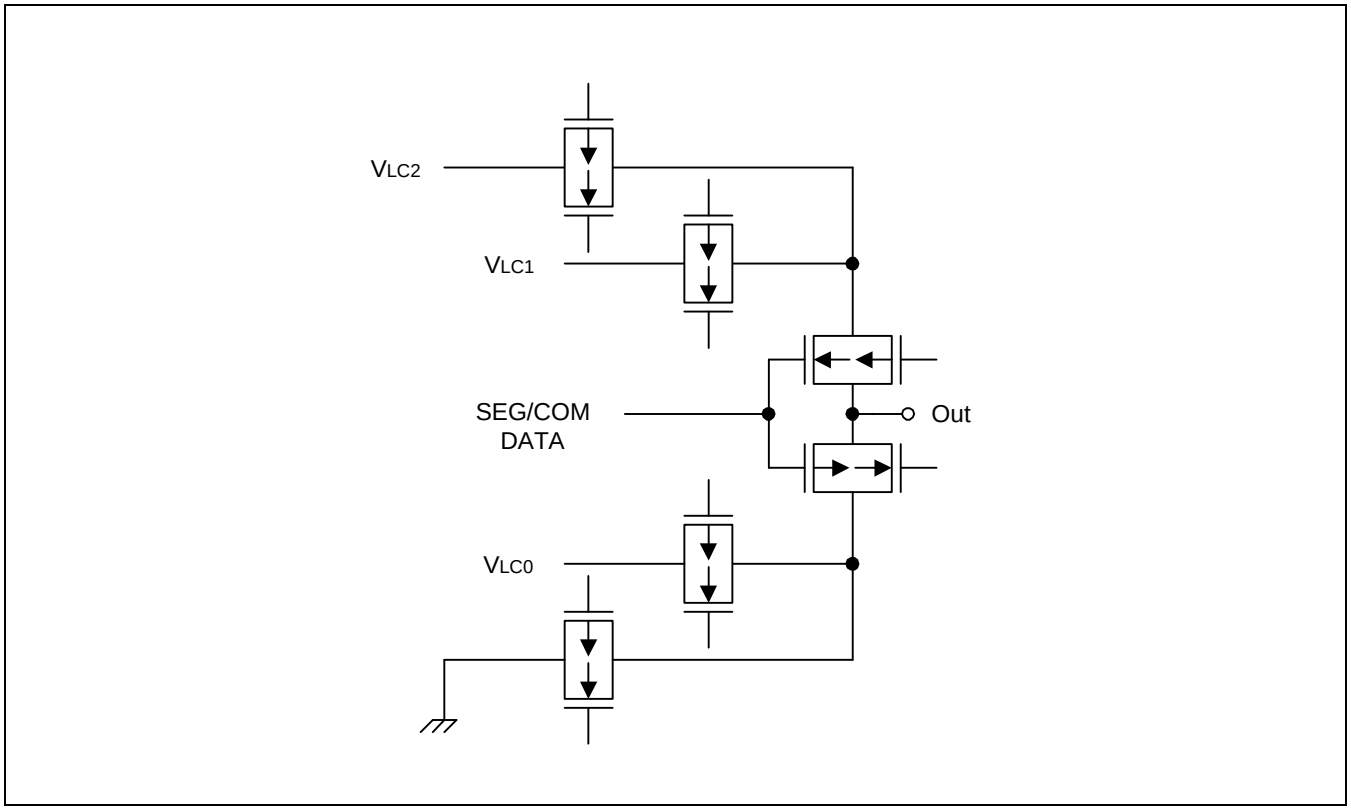


Figure 1-8. Pin Circuit Type H-16 (COM/SEG)

16 ELECTRICAL DATA

OVERVIEW

In this section, information on S3C72H8 electrical characteristics is presented as tables and graphics. The information is arranged in the following order:

Standard Electrical Characteristics

— Absolute maximum ratings
— D.C. electrical characteristics
— Main system clock oscillator characteristics
— Subsystem clock oscillator characteristics
— I/O capacitance
— A.C. electrical characteristics
— Operating voltage range

Miscellaneous Timing Waveforms

— A.C timing measurement point
— Clock timing measurement at X_{IN}
— Clock timing measurement at XT_{IN}
— TCL timing
— Input timing for RESET
— Input timing for external interrupts

Stop Mode Characteristics and Timing Waveforms

— RAM data retention supply voltage in stop mode
— Stop mode release timing when initiated by RESET
— Stop mode release timing when initiated by an interrupt request

Table 16-1. Absolute Maximum Ratings

(T_A = 25 °C)

Parameter	Symbol	Conditions	Rating	Units
Supply Voltage	V_{DD}	–	– 0.3 to + 6.5	V
Input Voltage	V_{IN}	–	– 0.3 to V_{DD} + 0.3	
Output Voltage	V_O	All I/O ports	– 0.3 to V_{DD} + 0.3	
Output Current High	I_{OH}	One I/O pin active	– 7	mA
		All I/O ports active	– 40	
Output Current Low	I_{OL}	One I/O pin active	+ 15	mA
		Total pin circuit	+ 60	
Operating Temperature	T_A	–	– 40 to + 85	°C
Storage Temperature	T_{STG}	–	– 65 to + 150	

Table 16-2. D.C. Electrical Characteristics

(T_A = – 40 °C to + 85 °C, V_{DD} = 1.8 V to 5.5 V)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Operation voltage	V_{DD}	F_{OSC} = 6 MHz (CPU clock = 1.25 MHz)	2.7	–	5.5	V
		F_{OSC} = 4.19 MHz (Instruction clock = 1.04 MHz)	2.0		5.5	
		F_{OSC} = 3 MHz (CPU clock = 0.75 MHz)	1.8		5.5	
Input High voltage	V_{IH1}	P0, P2, P3, P4, P5 and P6	0.8 V_{DD}	–	V_{DD}	
	V_{IH2}	RESET	0.85 V_{DD}		V_{DD}	
	V_{IH3}	X_{IN}	V_{DD}-0.1		V_{DD}	
Input low voltage	V_{IL1}	P0, P2, P3, P4, P5 and P6		–	0.2 V_{DD}	
	V_{IL2}	RESET			0.3 V_{DD}	
	V_{IL3}	X_{IN}			0.1	
Output high voltage	V_{OH1}	V_{DD} = 5.0V, I_{OH} = – 1 mA, All output pins	V_{DD} – 1.0	–	–	V
		I_{OH} = – 100 µA	V_{DD} – 0.5			
Output low voltage	V_{OL1}	V_{DD} = 5.0 V, I_{OL} = 2 mA, All output pins except V_{OL2}	–	0.4	0.5	
	V_{OL2}	V_{DD} = 5.0 V, I_{OL} = 15 mA, Ports 2,3, and 4		0.4	1.0	

Table 16-2. D.C. Electrical Characteristics (Continued)

(T_A = – 40 °C to + 85 °C, V_{DD} = 1.8 V to 5.5 V)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input high leakage current (note)	I_{LIH1}	V_{IN} = V_{DD} All input pins	–	–	3	µA
Input low leakage current (note)	I_{LIL1}	V_{IN} = V_{DD}; All input pins except RESET	–	–	– 3	
Output high leakage current (note)	I_{LOH}	V_{OUT} = V_{DD} All I/O pins and output pins	–	–	3	
Output low leakage current (note)	I_{LOL}	V_{OUT} = 0 V All I/O pins and output pins	–	–	– 3	
Pull-up resistors	R_{L1}	V_{IN} = 0 V, V_{DD} = 5 V T_A = 25 °C, Ports 0-6	25	47	100	KΩ
		V_{DD} = 3 V	50	90	150	
	R_{L2}	V_{IN} = 0 V; V_{DD} = 5.0 V T_A = 25 °C, RESET	150	250	350	
Oscillator feed back resistors	R_{OSC1}	V_{DD} = 5.0 V, T_A = 25 °C X_{IN} = V_{DD}, X_{OUT} = 0V	400	700	1200	
	R_{OSC2}	V_{DD} = 5.0 V, T_A = 25 °C XT_{IN} = V_{DD}, XT_{OUT} = 0V	1000	1500	3000	
$\|V_{LC1}$-COMi$\|$ Voltage Drop (I = 0-3)	V_{DC}	-15 uA per common pin	–	–	120	mV
$\|V_{LC1}$-SEGi$\|$ Voltage Drop (I = 0-25)	V_{DS}	-15 uA per segment pin	–	–	120	

NOTE: Except X_{IN}, X_{OUT}, XT_{IN}, XT_{OUT}

Table 16-2. D.C. Electrical Characteristics (Continued)

(T_A = – 40 °C to + 85 °C, V_{DD} = 1.8 V to 5.5 V)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Supply Current (note)	I_{DD1}	Main operation mode: V_{DD} = 5 V ± 10%, 6-MHz crystal		–	3.5	8	mA
		V_{DD} = 5 V ± 10%, 4.19 MHz			2.5	5.5	
		V_{DD} = 3 V ± 10%, 6-MHz crystal			1.6	4	
		V_{DD} = 3 V ± 10%, 4.19 MHz			1.2	3	
	I_{DD2}	Main Idle mode: V_{DD} = 5 V ± 10%, 6-MHz crystal		–	1.8	3.5	
		V_{DD} = 5 V ± 10%, 4.19 MHz			1.4	3.0	
		V_{DD} = 3 V ± 10%, 6-MHz crystal			0.6	1.2	
		V_{DD} = 3 V ± 10%, 4.19 MHz			0.5	1.1	
	I_{DD3}	Sub operation mode: V_{DD} = 3 V, 32768Hz Main OSC stop, except I_{VB}, I_{VLD}, Icomp, I_{LCD} and external load.		–	15	30	uA
	I_{DD4}	Sub Idle mode; V_{DD} = 3.0, 32768Hz Main OSC stop, except I_{VB}, I_{VLD}, Icomp, I_{LCD} and external load.		–	6	15	
	I_{DD5}	Stop mode; Main & Sub OSC stop, V_{DD}=5 V ± 10% except I_{VD}, I_{VLD}, Icomp and external load.	SCMOD = 0100B XT_{IN} = 0V-	–	0.3	3	uA
		Stop & Sub OSC stop, V_{DD} = 3 V, except I_{VD}, I_{VLD}, Lcomp and external load.			0.1	1	

NOTE: Supply current does not include current drawn through internal pull-up resistors or external output current loads. I_{LCD} is LCD controller/driver operating current, I_{VB} is voltage booster current, Icomp is comparator current and I_{VLD} is voltage level detector current.

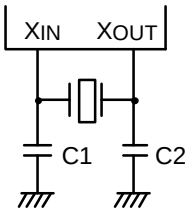
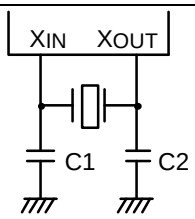
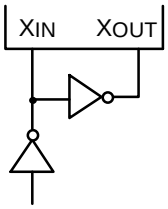
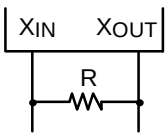
Table 16-3. Data Retention Supply Voltage in Stop Mode

(T_A = – 40 °C to + 85 °C)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Data retention supply voltage	V_{DDDR}		1.0	-	5.5	V
Data retention supply current	I_{DDDR}	V_{DDDR} = 1.0 V Stop mode; Main & Sub OSC stop. except I_{VB}, I_{VLD}, I_{LCD} and external load.	-	-	1	uA

Table 16-4. Main System Clock Oscillator Characteristics

(T_A = – 40 °C + 85 °C, V_{DD} = 1.8 V to 5.5 V)

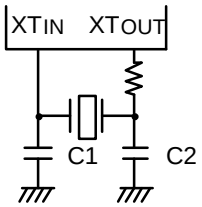
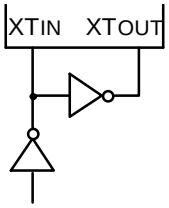
Oscillator	Clock Configuration	Parameter	Test Condition	Min	Typ	Max	Units
Ceramic Oscillator		Oscillation frequency (1)	–	0.4	–	6.0	MHz
		Stabilization time (2)	Stabilization occurs when V_{DD} is equal to the minimum oscillator voltage range.	–	–	4	ms
Crystal Oscillator		Oscillation frequency (1)	–	0.4	–	6	MHz
		Stabilization time (2)	V_{DD} = 4.5 V to 5.5 V	–	–	10	ms
			V_{DD} = 2.0 V to 4.5 V	–	–	30	
External Clock		X_{IN} input frequency (1)	–	0.4	–	6.0	MHz
		X_{IN} input high and low level width (t_{XH}, t_{XL})	–	83.3	–	–	ns
RC Oscillator		Frequency (1)	V_{DD} = 5 V R = 25 K, V_{DD} = 5 V R = 50 K, V_{DD} = 3 V	0.4	– 2.0 1.0	2.5	MHz

NOTES:

1. Oscillation frequency and X_{IN} input frequency data are for oscillator characteristics only.
2. Stabilization time is the interval required for oscillator stabilization after a power-on occurs, or when stop mode is terminated.

Table 16-5. Subsystem Clock Oscillator Characteristics

(T_A = – 40 °C + 85 °C, V_{DD} = 1.8 V to 5.5 V)

Oscillator	Clock Configuration	Parameter	Test Condition	Min	Typ	Max	Units
Crystal Oscillator		Oscillation frequency (1)	–	32	32.768	35	kHz
		Stabilization time (2)	V_{DD} = 4.5 V to 5.5 V	–	1.0	2	s
			V_{DD} = 1.8 V to 4.5 V	–	–	10	
External Clock		XT_{IN} input frequency (1)	–	32	–	100	kHz
		XT_{IN} input high and low level width (t_{XTL}, t_{XTH})	–	5	–	15	us

NOTES:
1. Oscillation frequency and XT_{IN} input frequency data are for oscillator characteristics only.
2. Stabilization time is the interval required for oscillating stabilization after a power-on occurs.

Table 16-6. A.C. Electrical Characteristics

(T_A = – 40 °C to + 85 °C, V_{DD} = 1.8 V to 5.5 V)

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Instruction cycle time (1)	^tCY	V_{DD} = 2.7 V to 5.5 V	0.67	–	64	µs
		V_{DD} = 1.8 V to 5.5 V	1.33	–	64	
TCL0, FCL input frequency	$^fTI0$, $^fTI0$	V_{DD} = 2.7 V to 5.5 V	0	–	1.5	MHz
		V_{DD} = 1.8 V to 5.5V			1	
TCL0, FCL input high, low width	$^tTIH0$, $^tTIL0$ ^tFCH, ^tFCL	V_{DD} = 2.7 V to 5.5 V	150	–	–	ns
		V_{DD} = 1.8 V to 5.5 V	250			
Interrupt input high, low width	^tINTH, ^tINTL	INT0	(2)	–	–	µs
		INT1, INT2 (KS0-KS3)	10			
RESET Input Low Width	^tRSL	Input	10	–	–	µs

NOTES
1. Unless otherwise specified, Instruction Cycle Time condition values assume a main system clock (fx) source.
2. Minimum value for INT0 is based on a clock of $2t_{CY}$ or 128/fx as assigned by the IMOD0 register setting.

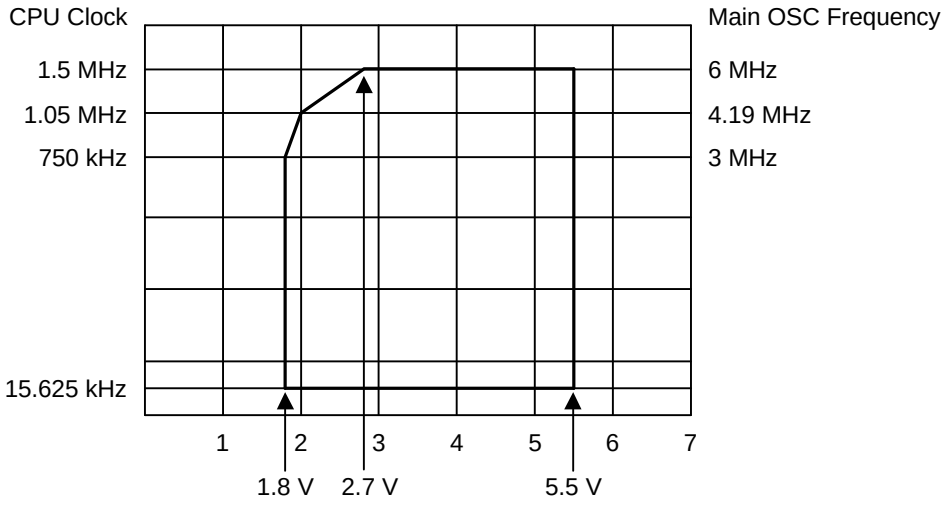


Figure 16-1. Standard Operating Voltage Range

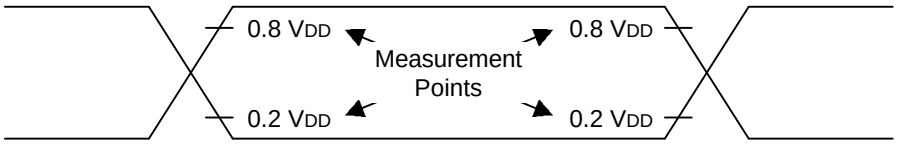


Figure 16-2. A.C Timing Measure Pints (Except for X_{IN} and XT_{IN})

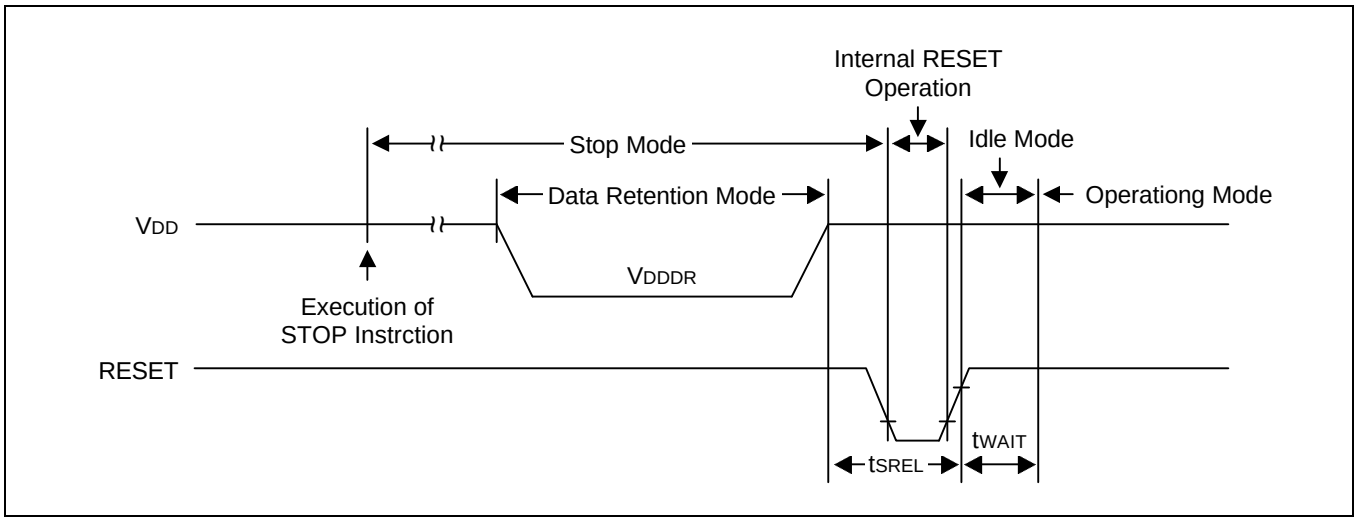


Figure 16-3. Stop Mode Release Timing When Initiated By RESET

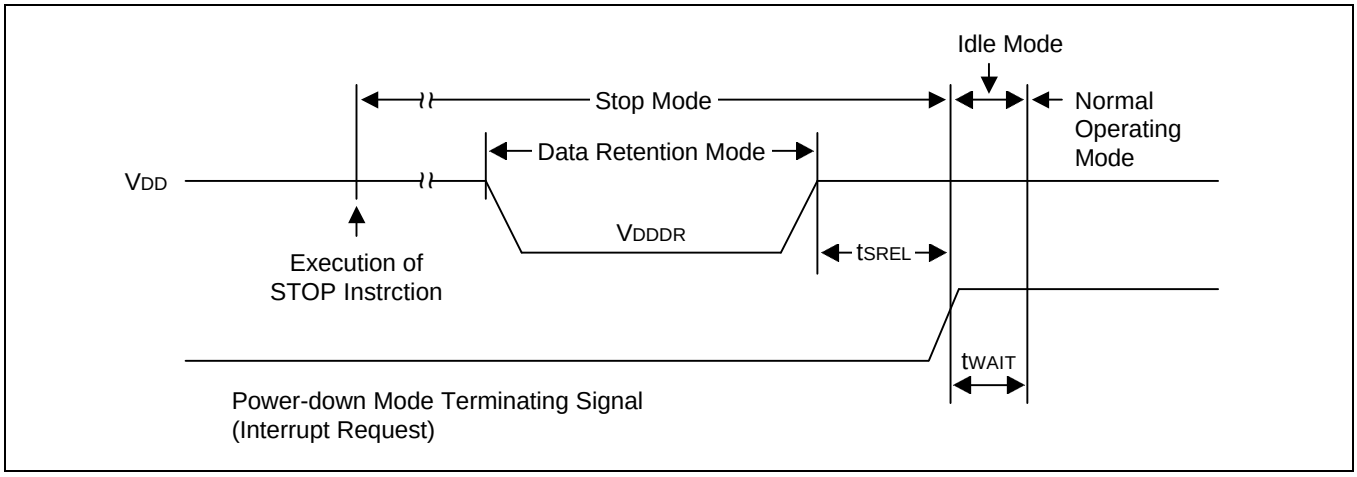


Figure 16-4.Stop Release Timing When Initiated By Interrupt Request

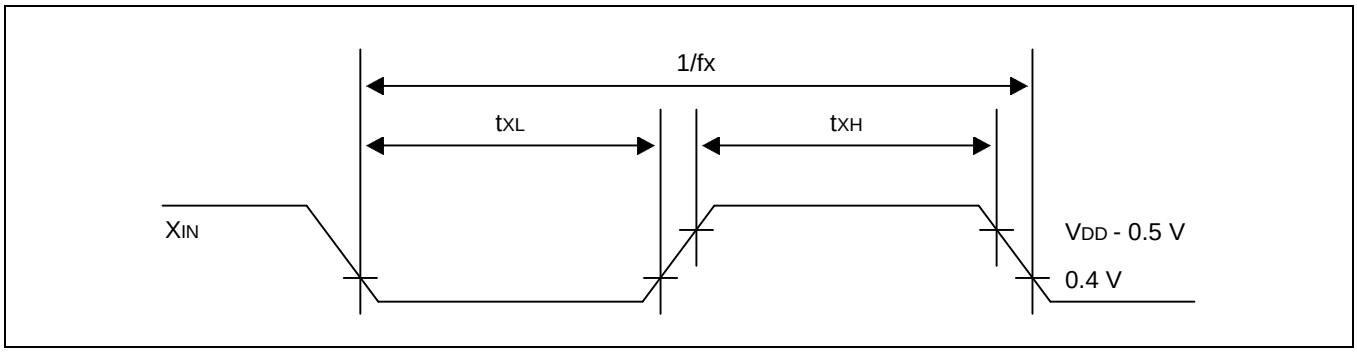


Figure 16-5. Clock Timing Measurement at X_{IN}

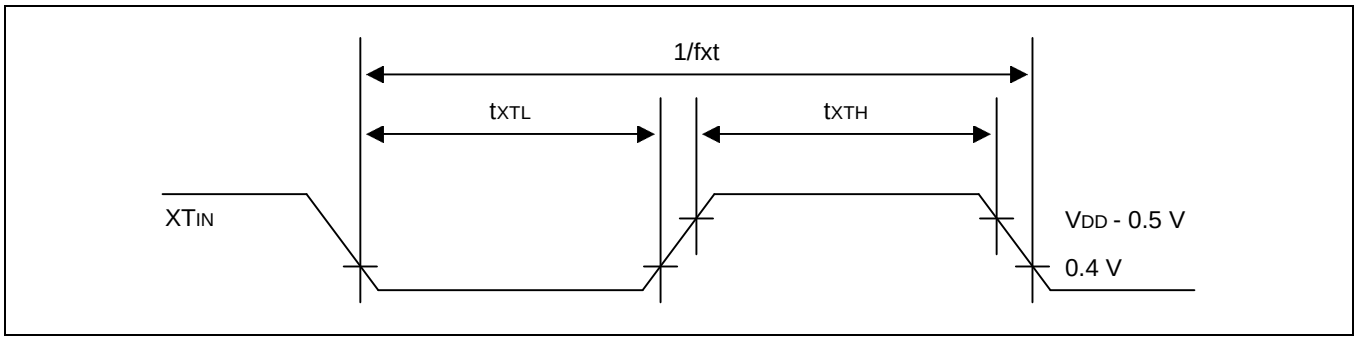


Figure 16-6. Clock Timing Measurement at XT_{IN}

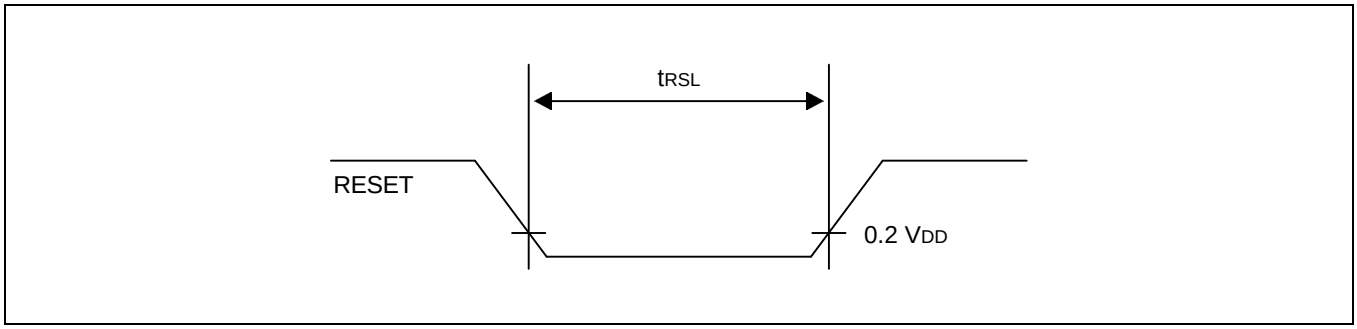


Figure 16-7. Input Timing for RESET Signal

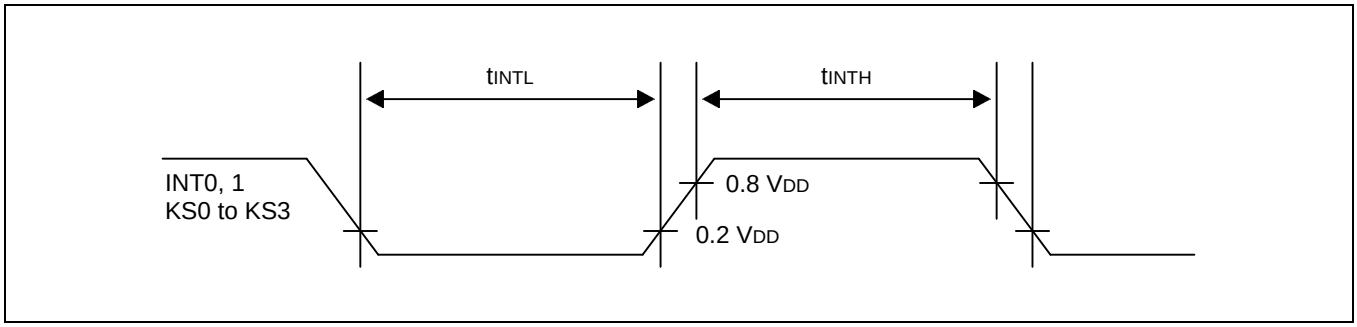
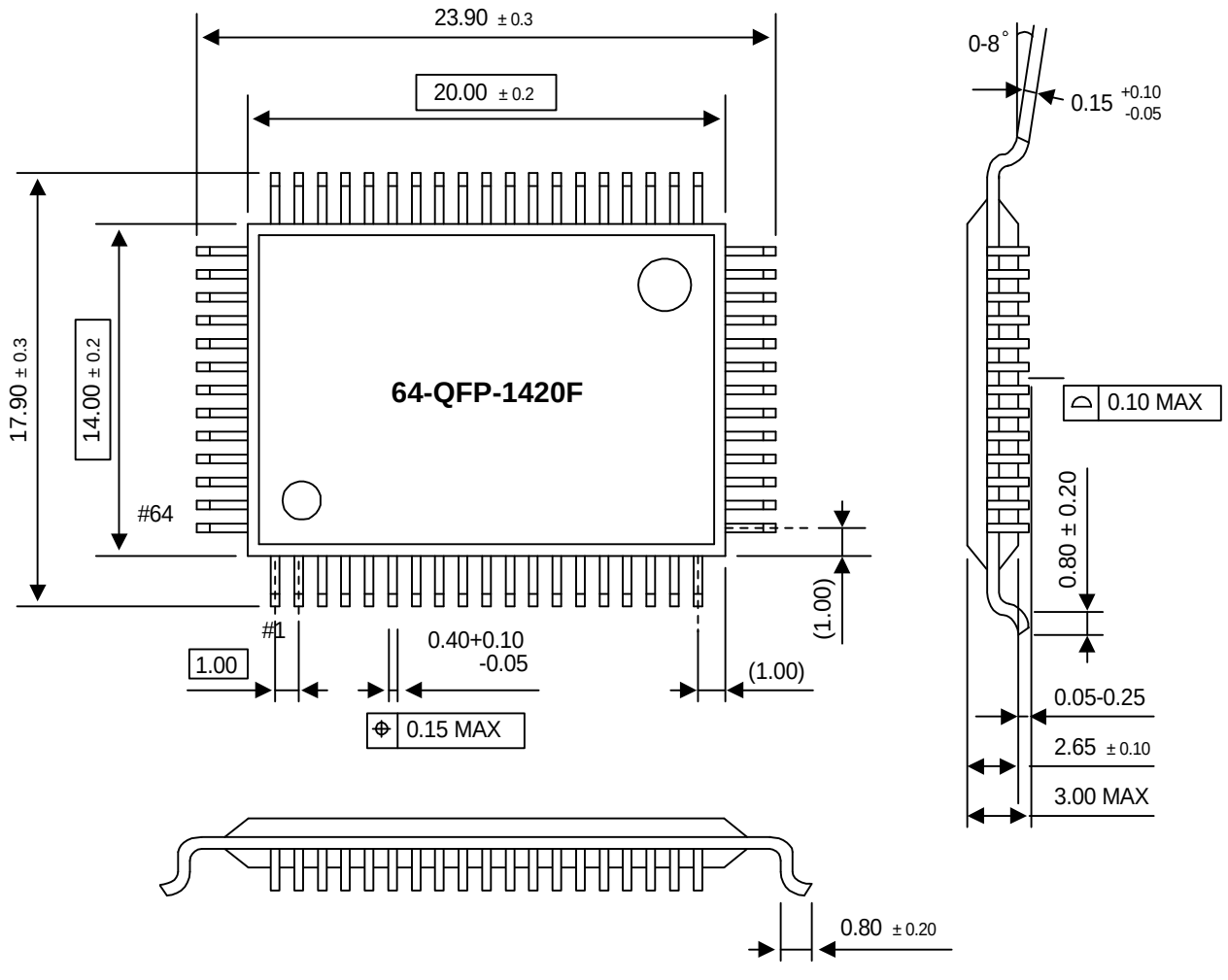


Figure 16-8. Input Timing External Interrupt

17 MECHANICAL DATA

OVERVIEW

The S3C72H8/P72H8 microcontroller is available in a 64-pin QFP package (Samsung: 64-QFP-1420F) Package dimensions are shown in Figure 17-1



NOTE: Dimensions are in millimeters.

Figure 17-1. 64-QFP-1420F Package Dimensions

18 S3P72H8 OTP

OVERVIEW

The S3P72H8 single-chip CMOS microcontroller is the OTP (One Time Programmable) version of the S3C72H8 microcontroller. It has an on-chip EPROM instead of masked ROM. The EPROM is accessed by a serial data format.

The S3P72H8 is fully compatible with the S3C72H8, both in function and in pin configuration. Because of its simple programming requirements, the S3P72H8 is ideal for use as an evaluation chip for the S3C72H8.

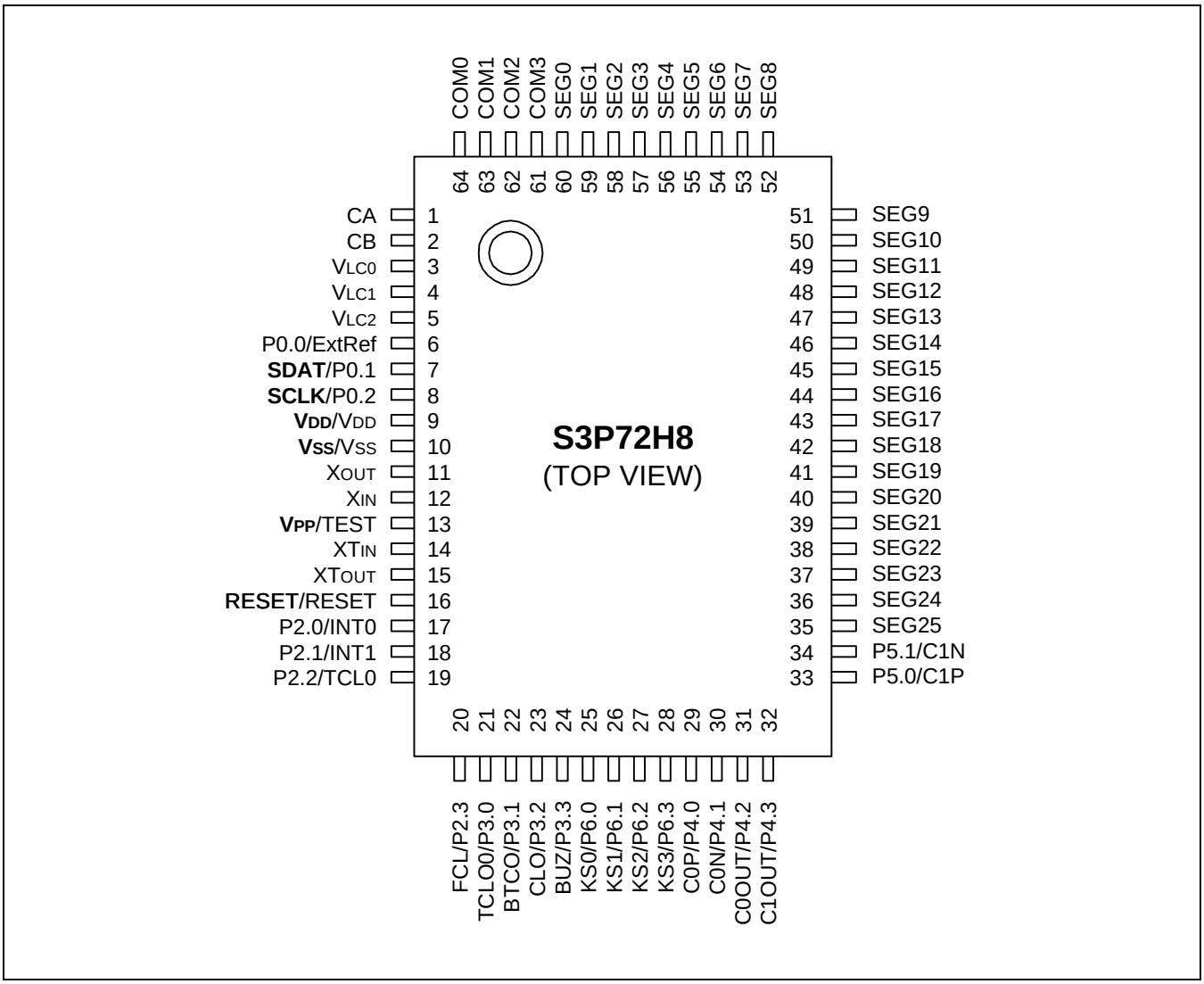


Figure 18-1. S3P72H8 Pin Assignments

Table 18-1. Pin Descriptions Used to Read/Write the EPROM

Main Chip	During Programming			
Pin Name	**Pin Name**	**Pin No.**	**I/O**	**Function**
P0.1	SDAT	7	I/O	Serial data pin. Output port when reading and input port when writing can be assigned as Input/push-pull output port respectively.
P0.2	SCLK	8	I/O	Serial clock pin. Input only pin.
TEST	V_{PP} (TEST)	13	I	Power supply pin for EPROM cell writing (indicates that OTP enters into the writing mode). When 12.5 V is applied, OTP is in writing mode and when 5 V is applied, OTP is in reading mode. (Option)
RESET	RESET	16	I	Chip initialization
V_{DD} / V_{SS}	V_{DD} / V_{SS}	9/10	I	Logic power supply pin. V_{DD} should be tied to + 5 V during programming.

Table 18-2. Comparison of S3P72H8 and S3C72H8 Features

Characteristic	S3P72H8	S3C72H8
Program Memory	8 K-byte EPROM	8 K-byte mask ROM
Operating Voltage (V_{DD})	1.8 V to 5.5 V	1.8 V to 5.5 V
OTP Programming Mode	V_{DD} = 5 V, V_{PP} (TEST) = 12.5 V	–
Pin Configuration	64 QFP	64 QFP
EPROM Programmability	User Program 1 time	Programmed at the factory

OPERATING MODE CHARACTERISTICS

When 12.5 V is supplied to the V_{PP} (TEST) pin of the S3P72H8, the EPROM programming mode is entered. The operating mode (read, write, or read protection) is selected according to the input signals to the pins listed in Table 18-3 below.

Table 18-3. Operating Mode Selection Criteria

V_{DD}	V_{PP} (TEST)	REG/ MEM	Address (A15-A0)	R/W	Mode
5 V	5 V	0	0000H	1	EPROM read
	12.5V	0	0000H	0	EPROM program
	12.5V	0	0000H	1	EPROM verify
	12.5V	1	0E3FH	0	EPROM read protection

NOTE: "0" means low level; "1" means high level.

Table 18-4. D.C. Electrical Characteristics

(T_A = – 40 °C to + 85 °C, V_{DD} = 1.8 V to 5.5 V)

Parameter	Symbol	Conditions		Min	Typ	Max	Units
Supply Current (note)	I_{DD1}	Main operation mode: V_{DD} = 5 V ± 10%, 6-MHz crystal		–	3.5	8	mA
		V_{DD} = 5 V ± 10%, 4.19 MHz			2.5	5.5	
		V_{DD} = 3 V ± 10%, 6-MHz crystal			1.6	4	
		V_{DD} = 3 V ± 10%, 4.19 MHz			1.2	3	
	I_{DD2}	Main Idle mode: V_{DD} = 5 V ± 10%, 6-MHz crystal		–	1.8	3.5	
		V_{DD} = 5 V ± 10%, 4.19 MHz			1.4	3.0	
		V_{DD} = 3 V ± 10%, 6-MHz crystal			0.6	1.2	
		V_{DD} = 3 V ± 10%, 4.19 MHz			0.5	1.1	
	I_{DD3}	Sub operation mode: V_{DD} = 3 V, 32768Hz Main OSC stop, except I_{VB}, I_{VLD}, Icomp, I_{LCD} and external load.		–	15	30	uA
	I_{DD4}	Sub Idle mode; V_{DD} = 3.0, 32768Hz Main OSC stop, except I_{VB}, I_{VLD}, Icomp, I_{LCD} and external load.		–	6	15	
	I_{DD5}	Stop mode; Main & Sub OSC stop, V_{DD}=5 V ± 10% except $I_{VD,}$ $I_{VLD,}$ Icomp and external load.	SCMOD = 0100B XT_{IN} = 0V-	–	0.3	3	uA
		Stop & Sub OSC stop, V_{DD} = 3 V, except $I_{VD,}$ $I_{VLD,}$ Lcomp and external load.			0.1	1	

NOTE: Supply current does not include current drawn through internal pull-up resistors or external output current loads. I_{LCD} is LCD controller/driver operating current, I_{VB} is voltage booster current, Icomp is comparator current, and I_{VLD} is voltage level detector current.

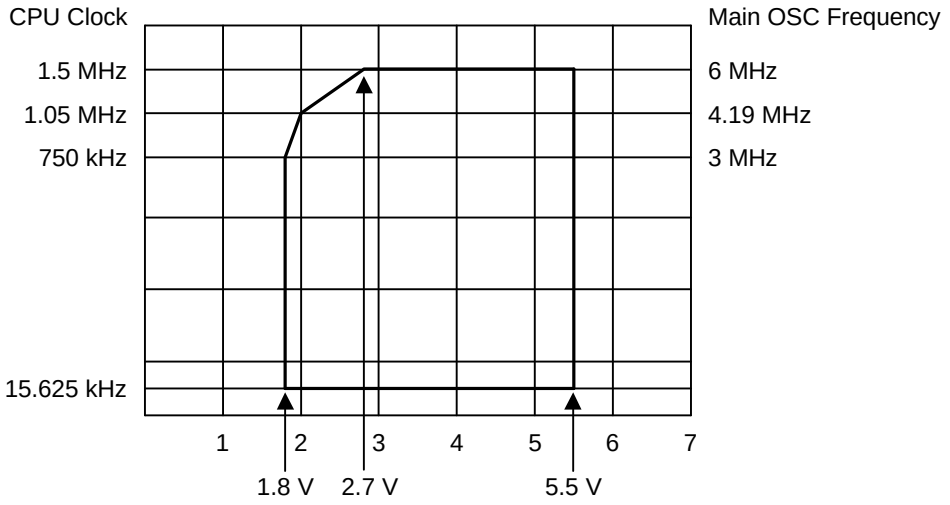


Figure 18-2. Standard Operating Voltage Range

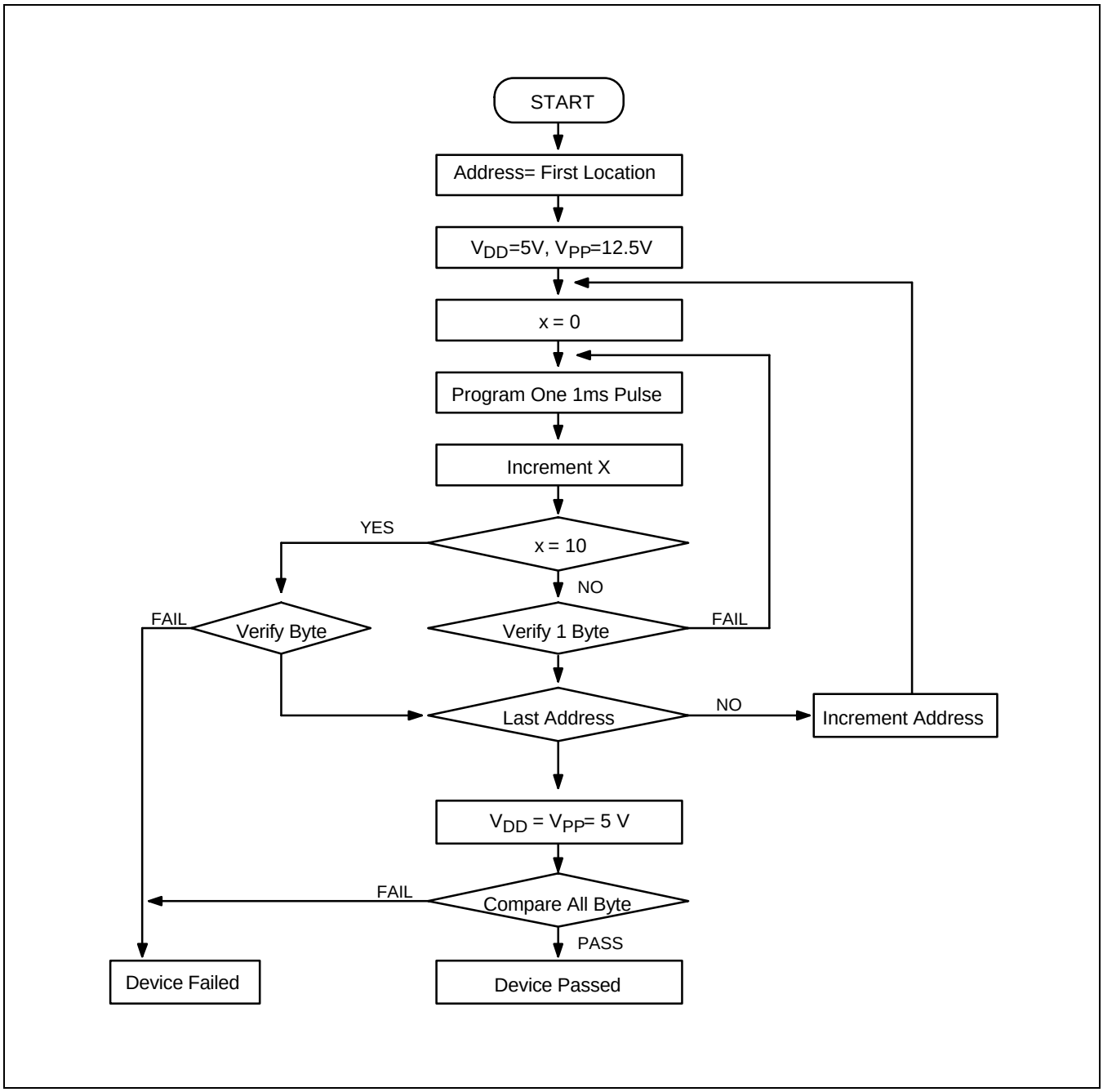


Figure 18-3. OTP Programming Algorithm